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- 1934 The use of E. C. in factories in theory
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By C.J. Harrison.

No. 1—1918.

Indian Tea Association.

TEA ROOTS,

PART II.

BY

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Calcutta:

PRINTED AT THE CRITERION PRINTING WORKS,
8, JACKSON LANE, CALCUTTA.

1918.

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TEA ROOTS.

DISEASE IN TEA ROOTS.

Watt & Mann. (The Pests and Blight of the Tea Plant 1903) referred to two diseases of tea roots, but no mention of the seriousness of the diseases was made. It would seem therefore that at that time root diseases had not demanded the attention they merit today. The loss due to root diseases has always been great and it was one of the first things to which the author's attention was drawn on his arrival in India. On almost every section on every garden there were bushes dying out here and there. The loss amounted to millions of bushes every year. It is difficult to estimate the cash value of a tea bush but it can be imagined that the annual loss of money was very large indeed. One of the large agency houses in Calcutta collected statistics from their gardens and decided that it would pay them to allow as much as sixty rupees per acre for preventive measures against root disease in young tea at the time of planting. Strangely enough comparatively few planters realised this and attempts at remedial treatment were in most cases only half hearted.

Loss due to root
disease

As a general rule the tea has suffered most from root diseases in districts which were originally under heavy forest. The Doon and Terai seem to be the worst affected and the districts along the foot hills of the mountains are generally more severely attacked than those out in the open plains. This is probably due to the forest being heavier near the hills.

Distribution.

TEA ROOTS.

The relation of
the causative
fungi to the soil.

Some fungi, e.g., *Hymenochaete noxia*, *Thyradaria tarda* and *Ustilina zovata* are most destructive on sandy soils. Indeed *Hymenochaete noxia* has only been found on sandy soils. *Rosellinia* Sp. and *Sphaerostilbe repens* have only been noticed on stiff soils. It would seem therefore that there is a definite relationship between the causative fungus and the soil in which the host plant is growing.

The resistance of
host plants.

In most cases it appears that the host plant is capable of resisting the attack of a root fungus and under good conditions an infected host plant may be able to prevent the fungus from causing much damage. This has happened in the case of many of the artificial inoculations carried out at Tocklai.

Present position
in regard to root
disease.

The present position in regard to root disease in North-East India is very satisfactory. As soon as the planters were shown the seriousness of these diseases and the ease with which they can be treated a campaign was made against them. One garden, where formerly as many as 12,000 deaths occurred in one year (1912) from *Hymenochaete noxia* is now practically free from that disease. Many other gardens, formerly badly infected, now have the diseases well in hand. The large numbers of dead bushes still being received at Tocklai shows that root diseases are still prevalent but they are now being treated in a scientific way and have ceased to be cause for serious alarm. The life histories of the fungi which cause all the common root diseases have been worked out in this laboratory, and the results of our observations are given in the following pages. The author has tried to avoid the use of technical terms and descriptions. The purely technical investigations which have led to the conclusions given in this pamphlet will probably be published later elsewhere.

HOW TO IDENTIFY THE COMMONER ROOT DISEASES OF TEA.

The following descriptions refer to the appearance of the dead root immediately after the death of the plant. If examination be delayed other fungi may mask the one which caused death.

EXTERNAL APPEARANCE OF THE ROOT—

- | | | | |
|--------------------------------------------------------------------------------|-----|------------------------------|--------------------|
| 1. Very rough with soil attached to it by a felt ... | ... | <i>Hymenochaete noxia.</i> | <u>Fomes lamae</u> |
| 2. Rough but with no soil attached | ... | <i>Ustulina zonata.</i> | <u>F. noxius</u> |
| 3. Smooth with thin strands of white mycelium turning smoky black with age ... | ... | <i>Rosellinia bothryina.</i> | |
| 4. Smooth sometimes wrinkled, of purplish colour ... | ... | <i>Sphaerostilbe repens.</i> | |
| 5. Smooth and apparently normal ... | ... | <i>Thyradaria tarda.</i> | |

INTERNAL APPEARANCE OF THE ROOT—

If the bark be peeled off with a knife so as to expose the wood the following appearances are characteristic :—

White fungus spreading over the surface of the wood.

- | | | |
|--------------------------------------------------------------------------------------------------------------------|-----|------------------------------|
| 1. Growing in delicate fans ... | ... | <i>Ustulina zonata.</i> |
| 2. Thick strands radiating from centres like the arms of a star fish, colour changing with age to violet black ... | ... | <i>Sphaerostilbe repens.</i> |
| 3. Thin strands white changing to smoky black ... | ... | <i>Rosellinia bothryina.</i> |

Changes in the appearance of the wood.—

- | | | |
|-----------------------------------------------|-----|------------------------------|
| 1. Brown veins arranged like a honey-comb ... | ... | <i>Hymenochaete noxia.</i> |
| 2. Black veins irregularly arranged | ... | <i>Ustulina zonata.</i> |
| 3. Black streaks running longitudinally ... | ... | <i>Thyradaria tarda.</i> |
| 4. Wood violet coloured and wet ... | ... | <i>Sphaerostilbe repens.</i> |

TEA ROOTS.

Wherever the plants have been dead for some time, fructifications of the fungi should be looked for and their appearance compared with the plates and descriptions given later.

Origin of attacks.

All the fungi which attack tea roots are capable of feeding on dead organic matter and it is not surprising to find that the origin of an attack of root disease in the case of all except *Thyradaria tarda* can generally be traced to a mass of decaying organic matter. It is usually an old tree stump but may be a fence post, a wooden bridge, a piece of firewood from a cooly's bundle or even a collection of dead leaves in a shady place. Wood buried a few inches below the surface of the ground is more likely to carry infection than wood lying on the surface except in the case of *Thyradaria tarda*. Some trees seem to be specially liable to act as centres of infection for various root diseases and are particularly dangerous, as they may show no signs of ill health for years after they have become infected. The Neem (*Melia azadirachta*), Silver oak (*Grevillea robusta*), Bhelawa (*Semecarpus anacardium*) and Jack fruit (*Artocarpus Sp.*) and various species of *Erythrina* may be specially noted.

Other trees are only attacked by the fungi after they have died from other causes their rotting stumps acting as centres of infection. The presence of dead stumps and logs in the vicinity of living trees is sure to cause trouble and should be avoided as far as possible. It is analogous to the presence of dead animals in the neighbourhood of a dwelling house. Unsatisfactory conditions of soil frequently account for attacks of *Rosellinia* and *Sphaerostilbe repens* while they probably make matters worse in the case of *Ustilina zonata* and the drainage should always be attended to, especially in stiff soils.

Treatment.

The first thing to do on noticing an attack of root disease is to prevent the disease spreading. All the fungi commonly causing root disease except *Thyradaria tarda* are able to spread from root to root below ground. It is therefore advisable to isolate the infected roots by a trench. As the disease may have attacked other bushes besides the ones already dead it is wise to dig a second

trench enclosing all the bushes adjoining the dead ones. Always throw the soil from the trenches inwards. The trenches should be left open. It is unnecessary to fill them up, or dust them, with lime as some people have been in the habit of doing. The dead roots should be dug right out, all the small roots as well. It is not such a difficult operation if the soil round the roots is thrown through a coarse sieve (say, one inch wire netting). The whole of the dead wood should be burned straight away. This treatment suffices in the case of *Ustilina zonata* and *Hymenochaete noxia* but in the case of *Rosellinia Sp.* and *Sphaerostilbe repens* the addition of lime to the soil is beneficial in making it less acid and more friable. In the case of *Thyradaria tarda* the trenches are unnecessary as the disease does not spread below ground.

At one time it was thought beneficial to treat the soil with a mixture of sulphate of ammonia and lime. This has been found to be beneficial but unnecessary. In view of the high price of sulphate of ammonia this treatment should be abandoned, and we no longer recommend it. If all the dead wood be removed the fungi are soon unable to cause further damage.

Hymenochaete nozia, Berk.

**History of the
fungus.**

The fungus which causes this disease is very common throughout the East. It was found in Samoa as a parasite causing considerable damage to bread fruit trees over 20 years ago. It was described as a serious disease of tea in Ceylon, by Petch. It also commonly attacks Rubber. The fungus is common throughout tropical Asia and it has also been reported in the West Indies and Nigeria. It would seem therefore to be found throughout the tropics. It is a very serious root disease of tea in North-East India.

Distribution.

It is especially prevalent on sandy soils in the Dooars and Terni and is the commonest root disease in all the districts which border the Himalayas. It some times occurs on red bank soils but it is not so common on them as *Ustilina zonata*. The sandy flats alongside the rivers are very badly attacked. It is not so prevalent in the other districts but is to be found in all.

**Symptoms of an
attack.**

As a general rule the first intimation a planter gets of an attack of this disease is the sudden death of two or three bushes adjoining one another. Sometimes as many as twenty will die out within a week. There is nothing in the stems and leaves to indicate the presence of fungus disease. As the death of the bushes frequently takes place after heavy rain during which thunder storms may have occurred it was frequently ascribed to the action of lightning. If however the roots of the bushes are dug up they will be found to be coated with brown crust which cements sand and stones to the roots. This may have taken many days to develop. The crust is formed of the mycelium of the fungus, which is cream coloured at first but changes to brown sometimes black later on. If the bark of the root be removed the wood will be seen to be marked with thin russet-brown lines which anastomose frequently. The lines define the limits of successive periods of growth of the fungus. They are cells filled with brown gum secreted by



Hymenochaete Noxia, Bark.

The illustration shows the characteristic rough appearance of a root attacked by this disease. Some small pieces of dead root show the brown streak in the wood and another one illustrates a later stage when all the wood between the brown streaks has decayed away, leaving a honeycomb.



Hymenochaete Noëlet, Berk.

This illustration gives a clearer view of the brown streaks in the wood of a root attacked by this fungus.

the plant, possibly in an effort to check the progress of the disease. Later on the wood between the plates is entirely consumed leaving a brown honeycomb. This stage does not usually occur until the plant has been dead sometime. The death of a few bushes is usually a forerunner of many deaths at the same place. Ring after ring of plants die out and if the disease is not checked acres of tea may be destroyed in a few years. In some cases the writer has seen as much as twenty acres of tea killed out in one patch. Fortunately the disease does not spread very rapidly from bush to bush; but, as it generally takes some months for an infected bush to die, a considerable number of plants in the neighbourhood of the dead bush may be infected and be spreading infection for a long time before the presence of the disease is suspected.

The origin of the attack of this disease is in most cases easily traceable to a piece of rotting wood. It may be an old fence post, a tree stump, or some old log. The following trees are specially liable to act as centres of infection:—

Origin and
progress of the
disease.

- Grevillea robusta* (Silver oak),
- Mesua ferrea* (Nahor),
- Erythrina indica* (Dadap),
- Cassia* sp. (Sonaru etc.),
- Melia azadirachta* (Neem),
- Semecarpus anacardium* (marking nut tree, Bhelawa).

These trees cause no offence as long as they are healthy but when they are diseased or cut down their roots are almost invariably attacked by this fungus. All such trees should be removed and their roots dug out to at least 2 feet below the surface of the soil. The disease spreads underground from root to root but is not capable of growing through the soil alone.

A microscopic examination of the tissues of tea roots killed by this disease shows that the mycelium of the fungus first of all attacks the bark cells and spreads from there to the wood and pith. It avoids the growing layers at first.

The fungus rarely fruits in North-East India. The writer has found only one specimen of the fruit body (immature) on tea

so far. The fructification is a brown plate of mycelium adhering to the collar just above the soil. Another immature fruitbody formed on a piece of gunny bag in which a diseased bush had been packed.

This fungus has been successfully grown in pure culture in the Tocklai laboratory but has never produced any fructifications.

Repeated attempts have been made by us to inoculate living roots with mycelium obtained from pure cultures but they were all unsuccessful. It was only found possible to obtain successful inoculations by tying pieces of dead wood previously inoculated with the mycelium of the fungus to the roots and then covering them up with the soil. The bushes did not die although the fungus grew satisfactorily for a time.

Bushes attacked by this disease should be surrounded immediately by a trench deep enough to isolate their roots from contact with those of their apparently healthy neighbours. To make sure of matters a second trench should be dug round the ring of bushes immediately adjoining the dead ones. The dead plants should then be dug out, all the soil should be passed through a sieve about an inch mesh so that all the small roots are removed. As the soil is always sandy this is not a difficult operation. It is very important that this be done as the fungus will live on dead wood for many years. The dead wood should be burned. If the soil is acid the acidity should be corrected by applications of lime as an acid soil is found to favour the disease. No other treatment is usually necessary.

Rosellinia bothrina, (B. & Br.) Sacc.

The genus *Rosellinia* is a large one and there is no doubt that more than one species attack tea. Unfortunately the species attacking tea do not fruit readily hence it has been impossible to identify them with certainty. The fructifications of one *Rosellinia* attacking tea in Darjeeling were found for the first time last year and enabled the disease to be identified as *Rosellinia bothrina*. *Rosellinia bothrina* is a common fungus in the tropics. It has been reported as a saprophyte on dead trees in many places and has been observed as a parasite on tea in Ceylon.

History of the disease.

It seems to cause most damage on the stiffer soils especially under excessive shade. It is not however confined to shady places. It is most common on gardens in the West of Darjeeling but a few specimens have been received from gardens in Upper Assam.

Distribution.

The fungus generally attacks the bush at the collar, completely ringing it. The plant usually attempts to repair the injury by swelling above the diseased portion and sending out rootlets. Sometimes the injury is repaired but usually the ringed stems die down. As a general rule the fungus does not spread much either on the roots or stems. It frequently dies away after causing the death of the stem leaving no trace to give a clue to the cause of the injury. The fungus is easily seen in its active state. It forms white threads which turn smoky black with age. These threads adhere to the outside of the bark of the stems and roots and here and there penetrate to form stars between the growing layers and the hard wood.

Symptoms of the disease

The fructifications are produced sometime after the commencement of the attack. One kind appears usually on the stems a little above the badly injured portions. This consists of short erect bristle-like stalks, produced in clusters, so as to give a velvety appearance to the surface. The stalks are branched above, each branch bearing colourless unicellular narrow oval spores, which

form a white or greyish powder on the surface. A second kind of fructification is produced on dead stems usually among the stalks. This consists of clusters of round black grains, like shot, each about 1/10 inch in diameter. These are spherical flasks. They contain another kind of spores.

The origin and progress of the disease.

The fungus generally originates in accumulations of dead leaves spreading from them over the surface of the soil. The fungus attacks the growing layers and medullary rays. It sometimes attacks the wood after the death of the host plant. The fungus under favourable circumstances may spread with remarkable rapidity. In dull damp weather it is possible to watch the strands of mycelium growing with the naked eye.

Treatment.

It is an easy disease to cure if taken in time. The first thing to do on noticing an attack is to remove all dead leaves and twigs from the soil surface. Afterwards lay bare the collars of all the plants round the diseased ones. Next cut away and burn all the diseased portions of the infected plants. Spray them with lime sulphur solution or any other good fungicidal solution. Finally fork two pounds of slaked lime into the topmost three inches of every square yard of soil in the infected area. If the above treatment be carried out promptly the disease will be prevented from spreading and the diseased bushes will generally come away again from their collars.



Ustilula caesia (Léve.) Sacc.

This illustration shows the two stages of the frutification.

Ustilina zonata, (Lév.) Sacc.

The fungus was first described by Lèveille as *Sphaeria zonata*. In 1882 it was redescribed in Saccardo as *Ustilina zonata*. It has long been known as a common parasitic and saprophytic fungus in the tropics. Patch in his Circular on the root diseases of tea asserts that it is the commonest root disease of tea in Ceylon. In 1911 it was observed by the writer to be very common in the tea districts of North-East India. It was noted in 1913 by Sharples to be causing a serious stem disease of rubber in the Federated Malay States.

History of the fungus.

This disease is one of the commonest root diseases of tea in North-East India. It is more frequent on sandy soil than on clay but it is not unknown on stiff silty soil.

Distribution.

Bushes attacked by this disease usually present an unhealthy appearance for a week or two before their death. Death comes suddenly often during every wet weather when the vitality of the plant is low. About the time the plant dies a soft white plate $\frac{1}{2}$ —3 inches in diameter forms on the bark of the collar. This plate may adhere to the collar or bend away from it like a bracket. The colour changes to black later and small dots appear in regular lines over the surface. At the same time the plate becomes brittle like charcoal. The external appearance of a diseased root is not characteristic but if the bark be removed the wood will be found covered with beautiful delicate white fans of mycelium which extend into the live portions of the tissues. In the dead portions the extreme edges of the fans are marked by a thin black line which extends some distance into the dead wood.

Symptoms of the disease.

The fungus first attacks the cortex and then the growing cells of the cambium extending into the medullary rays. The fungus does not feed on the lignified tissue in the early stages of the attack. At intervals the mycelium of the fungus agglomerates to form black plates. The edges of which are seen as the

The life history of the fungus.

black lines when the wood is cut. These thin black lines must not be taken as characteristic as similar lines are produced by other fungi. The fine fan-like plates of white mycelium which spread over the wood beneath the bark differ in appearance from those produced by any of the other root fungi of tea and may be considered characteristic of the disease. The fructifications are formed early in the attack and continue to form after the death of the host plant. They are described above. The first stage produces spores on its surface. Later another kind of spore is produced in tiny cavities inside the fructification. The mouths of these cavities form black dots on the surface of the fructification.

*Identity of the
fungus*

The size of the spores correspond with the figures given by Massee, Petch and Sharples for specimens from Ceylon and the Malay States and there is no doubt that this fungus is identical with the one which causes so much damage in those countries. It is also said to be present on tea in Southern India.

*Artificial
inoculations.*

Attempts which we have made to infect bushes by spore inoculations did not succeed but there is no doubt that infection does take place by means of spores as specimens have been received with the fungus growing from dead snags and not in contact with the root at all. Inoculations which we have carried out on the roots of bushes below ground using pure cultures growing on wood or portions of the mycelium from pure cultures succeeded but did not kill the plants inoculated. It would seem therefore that healthy plants are able to throw off the disease.

Treatment.

The treatment of *Ustilina zonata* is very simple. It is only necessary to dig up and burn all the roots of the dead bushes immediately they are noticed. If it is impossible to do this at once the dead bushes should be isolated by a trench to prevent the disease spreading. It is hardly necessary to point out the desirability of removing, and as far as possible preventing the formation of, dead snags.



Ustilium montu, (Lév.) Sacc.

The plate shows a root with portion of the bark removed revealing the delicate white fans of fungus which are characteristic of the disease. Above the collar, the fruit body, a black crust is shown.



Sphaerostilbe repens, B. & Br.

The beautiful arrangement of the strands of fungus beneath the bark is clearly shown.

Sphaerostilbe repens, B. & Br.

The fungus was named by Berkeley and Broome in "Fungi of Ceylon" in 1875. The fungus was recorded as parasitic on rubber in Ceylon in 1907. In 1910 the fungus was described by Petch in a Circular of the Royal Botanic Garden, Ceylon. It has not hitherto been described as a parasite on tea. Last year, in the course of the author's investigations on the fungi which attack tea roots, the roots of a number of bushes which were supposed to have been killed by a waterlogged condition of the soil were observed to be attacked by a fungus which had not been noticed on tea before. There were no fructifications present. Cultures were made from the mycelium of the fungus and on these the typical fructifications of *Sphaerostilbe repens* formed. Further specimens of diseased tea roots which bore the fructifications in profusion were obtained later. It was found on investigation that unhealthy tea bushes growing on acid, stiff, badly drained soils were very frequently attacked by this disease.

History of the fungus.

It appears to be common in all districts where suitable conditions are present. It has not so far been observed on well drained soil. The tea growing on the stiff clay soil which is frequently found round the base of teelas in Cachar and badly drained clay flats is generally attacked to some extent by the disease.

Distribution.

A bush attacked by this disease looks sickly. Red rust and other diseases which usually accompany debility generally attack its leaves and stems. If the bush be dug up the roots will be found to present a waterlogged appearance. The roots also have a peculiar smell something like vinegar. The bark is a violet colour and under the bark thick strands of fungus mycelium radiate starwise over the wood. These strands are usually orange when young changing to a pinkish purple later. The fruit bodies may not be present but the other characteristics of the disease are so obvious that there is no difficulty in diagnosing the disease in their absence.

Symptoms of the disease.

**Origin and
progress of the
disease.**

The attack usually originates in a stump of a tree.—frequently a Jack fruit—and spreads from there through the soil from bush to bush. The thick strands of mycelium are able to grow through the soil like roots. The disease thus spreads from root to root. The bushes do not die at once. It probably takes some years to kill them. The disease is not always fatal. The condition of the soil is the determining factor. If the soil conditions are improved the bushes frequently recover, and as the attack is slow the condition can be determined and remedied before the bushes die.

There are two kinds of fructifications. They are produced on bark of the collar and exposed portions of roots. The first form to appear consists of short red stalks $1/12$ — $1/3$ inch long surmounted by a white head. Other fungi produce similar fructifications but they have smooth stalks while those of the fungus in question have hairy ones. The hairiness is lost to some extent with age. The knob at the end is a mass of the hyphae resembling a brush. The spores are borne on the ends of the hyphae. The second form of fructification is produced later. It consists of number of small dark red flask shaped bodies crowded together at the bases of the stalks or at other places whenever the mycelium is exposed.

The fungus grows freely in pure culture but so far no inoculations have succeeded and it seems probable that special soil conditions are required for infection to take place, and that these cannot be reproduced in the laboratory with our present knowledge.

Treatment.

The treatment which has so far been quite successful is to surround the patch of sickly bushes by a trench deep enough to isolate the roots of the diseased bushes from those of healthy ones and to open up the soil by trenches between each row of bushes, mixing slaked lime with the soil at the rate of four lbs. per square yard.



Thyridaria tophi, Bower.

The root illustrated in the plate shows large numbers of black dots on its surface. These are the fructifications of the fungus.

Thyradaria tarda, Banc.

The disease caused by this fungus is sometimes known as "die-back" but this name is much more applicable to another disease caused by a species of *Gleosporium*. Another name is "internal root disease." The latter is the better name although it is hardly fair to call it a root disease. The fungus which causes this disease is one of the most widely distributed saprophytes in the tropics. It seems to be everywhere. For instance we notice that if a dead tea bush is left on the office verandah for a month or so it is almost invariably attacked by it. As a parasite attacking living trees it is not so much in evidence but it seems capable of attacking most woody trees under certain conditions.

History of the fungus.

Owing to the extraordinary variability of the fruiting stage of the fungus it has been given a number of different names. It is only necessary to mention those by which it has been known to tea planters. Watt and Mann call the fungus *Diplodia* sp. and Petch describes it as *Botryodiplodia-theobromae* Pat. Recently however Bancroft has brought forward evidence to prove that *Botryodiplodia theobromae* Pat. is a stage of the fungus he has called *Thyradaria tarda*. From investigations on the *diplodia* tea disease in North-East India it is evident that it is caused by the same fungus.

Identity of the fungus.

Thyradaria tarda is found as a parasite on tea in all the districts of North-East India. It is serious only on two or three gardens in Bishnath and the Dooars on very sandy soil liable to drought. It is interesting to note that drought succeeding the pruning leads to increased attacks of this disease on gardens where it is prevalent. The disease is practically unknown on cleared forest land but it is fairly common on old grass land.

Distribution.

A plant attacked by this disease at first shows no indication of disease except in a few cases where the veins of the leaves darken a little in colour. Suddenly without any warning the bush dies

with all its leaves attached just as though it had been struck by lightning. If the bush be dug up no sign of disease of the roots will be found. They appear to be quite normal. If the dead bush be allowed to dry for a day or two the whole of the roots will present a sooty appearance due to the presence of innumerable spores emerging from spherical cavities which protect the spores while they mature. If the roots and stems be split the wood will be found to be a greyish colour very much as if it had been dipped in blue black ink and allowed to dry.

Progress of the disease.

The fungus attacks the pith and wood of the stems and roots and may live for a long time in those portions of the plant without appearing to cause inconvenience. It only makes its presence known when it suddenly attacks the layers of active tissues in the bushes. Pruning seems to bring about the conditions required to attract the fungus to these layers and as a rule the plants die shortly after pruning.

So far no inoculation experiments on tea in North-East India have succeeded and it seems probable that the fungus can only attack plants under special conditions which we have not yet been able to determine. One investigator suggests that the fungus attacks the plants at injuries while the injured portions are drying. Possibly the relative amounts of air and water in the tissues are the determining factors in infection. It is however certain that whatever the conditions favourable to infection are they are fortunately not common in North-East India.

Treatment.

The most satisfactory treatment of the disease appears to be simply the removal and destruction of the diseased bushes. Pruning on infected areas should be followed immediately by an application of fungicidal spray fluid to protect the wounds. Lime-sulphur solution appears to be quite satisfactory for this purpose. The soil should then be provided with more organic matter so that it can hold more water and the effects of drought will thus be reduced. It is no use trying to eradicate the fungus as it is too generally distributed.



Puccinia bidentis, (Lays.) Fr.

The illustration shows a large bracket-shaped fructification of the fungus projecting from the collar of a dead tea bush. Thick cords of fungous mycelium may be noticed on the root in the foreground.

Other root diseases.

Besides the fungi mentioned before there are a number of others which occasionally attack tea. *Fomes lucidus* has been found attacking tea on some gardens. Another fungus, at present unidentified, is frequently found on dead tea roots. Its fructification is borne at the collar and consists of tufts of branching black strands about a quarter of an inch long. This fungus does not appear to be parasitic under ordinary conditions.

